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FOURTH INTERIM REPORT  
OF THE  
PLANNING SUBCOMMITTEE  
OF THE  
FCC ADVISORY COMMITTEE  
ON  
ADVANCED TELEVISION SERVICE

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Subcommittee Chairman

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## EXECUTIVE SUMMARY

This is the fourth interim report of the Planning Subcommittee of the FCC's Advisory Committee on Advanced Television Systems. In the Subcommittee's Third Interim Report, submitted in March 1990, several issues were identified as requiring expeditious resolution to permit testing to proceed as planned. Pursuant to the direction of the Advisory Committee, and thanks to the generosity and hard work of many individuals and firms, these matters have been addressed successfully. The testing of proponent systems, while postponed for several months, is now set to begin in a matter of weeks.

This report comprises work conducted by the Planning Subcommittee between January 1990 and January 1991. During this period, a substantial portion of the Advisory Committee's attention has been placed on making the final preparations for the onset of ATV tests. Nevertheless, most of the Planning Subcommittee's Working Parties have seen some activity.<sup>1</sup>

Working Parties 1 and 2 (PS/WP-1, Technology Attributes and Assessment and PS/WP-2, Testing and Evaluation Specifications) met jointly to amend slightly in coordination with Systems Subcommittee Working Party 2, the ATV attributes list. Working Party 4 (PS/WP-4, Alternative Media Technology and Broadcast Interface) monitored activities of other organizations, and

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<sup>1</sup>Advisory Groups 1 and 2 (PS/AG-1, Creative Issues and PS/AG-2, Consumer and Trade Issues) were idle during this period.

identified issues for study by these groups concerning conditional access.

Working Party 5 (PS/WP-5, Economic Factors and Market Penetration) worked jointly with Systems Subcommittee Working Party 3 to further model ATV receiver penetration. With the benefit of independent studies from CBS and PBS, these working parties also made important contributions in better articulating the expected transitional costs which local broadcast stations might face in implementing a new ATV transmission system."

Previously, Working Party 7 (PS/WP-7, Audience Research) was able to develop a comprehensive research program to investigate consumer reactions to advanced television systems. Unfortunately, the research has not been executed due to lack of financial support from industry, foundation, or government sources.

Of all the components of the Planning Subcommittee, the busiest have been Working Parties 3 (PS/WP-3 Spectrum Utilization and Alternatives) and 6 (PS/WP-6 Subjective Assessment). PS/WP-3 began an intensive examination of issues related to the distribution of advanced television signals. The Working Party also continued its efforts to analyze the broadcast spectrum requirements of ATV systems, undertaking studies of ATV accommodation statistics under various conditions.

In addition, attention was placed on formulating an approach for evaluating and comparing the laboratory data of particular ATV systems, and the analytical tools needed in this regard are

already being developed. Finally, in response to a request from Systems Subcommittee Working Party 4 (ATV Standard), PS/WP-3 also created a list of spectrum-related attributes that a preferred ATV system should possess.

For its part, PS/WP-6 has been totally occupied with the many tasks associated with creating the ATV source material. Despite both the complexities inherent in producing more than a dozen scenes, "identical" in each of five video formats (four ATV and NTSC), and the lack of funding initially, the project has been completed successfully. The activity could not have been completed had it not been for the generosity of the proponents and the test labs and the very hard work of dozens of volunteers who worked together cooperatively on this important undertaking.

Although the Planning Subcommittee will experience a further dwindling of responsibilities as the testing and subsequent stages of the Advisory Committee's work commence, Working Parties 3, 5 and 6 will remain active. PS/WP-6 will administer the expert viewer panels that will be used in the ATV testing program. The viability of this effort hinges on these experts receiving adequate support, and it is envisioned that such support will be forthcoming from the respective organizations that employ these individuals. Members of the parent Advisory Committee that are employers of potential participants on the expert viewer panels are urged to commit support for this effort explicitly.

In addition, PS/WP-3 will analyze laboratory data and produce quantitative comparisons of the coverage and interference characteristics of the various ATV systems. The effectiveness of PS/WP-3's work would be enhanced significantly if the Advisory Committee were to define with specificity the importance that ought to be placed on particular ATV system attributes. In addition, the Advisory Committee is asked to confirm the goal of the Planning Subcommittee to develop actual channel assignment plans for terrestrial transmission of advanced television-in the United States.

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## **I. INTRODUCTION**

This is the fourth interim report of the Planning Subcommittee of the FCC's Advisory Committee on Advanced Television Service. The report can only summarize the tremendous amount of work performed by members of the Subcommittee between January 1990 and January 1991. A full accounting of this effort is reflected in the many documents which have been submitted to the Working Parties. The energy and dedication of all participants is gratefully acknowledged.

In addition to recapping the progress of the Subcommittee over the past 12 months, this Interim Report presents an overview of the work that remains. Advisory Committee attention is also directed to matters whose resolution could make the efforts of the Planning Subcommittee more effective.

The Report is organized as follows. The next section presents a brief summary of previous Subcommittee work. The third section describes the assignments each Working Party received, and section four details the progress made by the various Working Parties over the past 12 months. Section five outlines the remaining work of the Subcommittee, and Section six presents conclusions and offers recommendations to the Advisory Committee.

## **II. BACKGROUND**

The accomplishments of the Planning Subcommittee in its previous phase of work (March 1989 to January 1990) were reported fully in the Subcommittee's Third Interim Report. In brief, they may be summarized as follows:

- Working Party 1 amended the list of ATV attributes to include ten new sets of characteristics. Working Party 2 reviewed these attributes and developed specifications for inclusion in the appropriate test plans.
- Working Party 3 initiated its assessment of auxiliary spectrum requirements, further defined the impact of taboos on spectrum availability, began coordination efforts with Canada and Mexico, and conducted a briefing for representatives of system proponents.
- Working Party 4 coordinated its earlier test plan and "multiport" receiver work with CableLabs and ATTC.
- Working Party 5 worked jointly with Systems Subcommittee Working Party 3 to further review the economic factors affecting ATV market demand and penetration.
- Working Party 6 made substantial headway toward developing the still and motion picture materials needed to conduct the subjective and objective tests.
- Working Party 7 reformatted four audience research study designs into RFPs.

## **III. NEW ASSIGNMENTS TO WORKING PARTIES FOR THE PERIOD JANUARY 1990 TO JANUARY 1991**

At a meeting of the Planning Subcommittee Steering Committee held April 10, 1990, new work assignments were

developed for the various Working Parties. These tasks are summarized below.<sup>1</sup>

**A. Working Party 1: Technology Attributes and Assessment and Working Party 2: Testing Evaluation and Specifications**

These two Working Parties were requested to meet jointly, and engage in three tasks. First, in coordination with SS/WP-2, the Working Parties were to ensure that the ATTC had complete audio and data channel test procedures prepared by July, 1990. Second, PS/WP-1&2 was assigned the job of developing a test methodology for the assessment of dynamic resolution provided by ATV transmission systems.

Finally, the two Working Parties were asked to define the scope and objectives for conducting field tests, and to solicit guidance from the FCC on this matter. In this regard, PS/WP-1&2 were required to coordinate with PS/WP-4 on cable related aspects of field testing, solicit proponents for characteristics of ATV transmitters, and coordinate this effort with PS/WP-3, and provide information obtained from these activities to SS/WP-2 Task Force on Field Test Procedures.

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<sup>1</sup> No assignments were given to either Advisory Group 1 or 2 (PS/AG-1 Creative Issues and PS/AG-2 Consumer and Trade Issues).

**B. Working Party 3: Spectrum Utilization and Alternatives**

PS/WP-6 was assigned the following seven specific tasks:

1. Develop preliminary channel allotment plans and assignment options based on inputs from the Systems Subcommittee and WP-3 developed planning factors.
2. Examine the benefits of co-location of ATV transmitters.
3. Develop necessary tools to characterize interference between NTSC and ATV, and recommend mutual interference reduction measures such as co-location.
4. Complete work on identifying the availability of spectrum to support ATV broadcast auxiliary operations (including satellite, STL, and ENG). Identify alternative auxiliary support strategies, such as fiber optics.
5. Develop a strategy to reduce data obtained from impairment testing to obtain meaningful evaluations of ATV transmission systems.
6. Coordinate with the Implementation Subcommittee on the evaluation of the economic implications versus the technical implications of adopting various simulcast allocation plans.
7. Coordinate with PS/WP-1 and PS/WP-2 to obtain transmitter characteristics from ATV system proponents.

**C. Working Party 4: Alternative Media Technology and Broadcast Interface**

PS/WP-4 was given three additional duties: 1) Review EIA/ATSC recommendations regarding multipoint specifications and, if appropriate, prepare a report to the Advisory

Committee Chairman; 2) Research potential compatibility conflicts between future Direct Broadcast Satellite systems and terrestrial ATV broadcast systems; and, 3) Coordinate with PS/WPs 1&2 to ensure that the field test plan encompasses end-to-end cable system testing.

**D. Working Party 5: Economic Factors and Market Penetration**

PS/WP-5 was asked to: 1) Estimate costs to convert present NTSC stations to ATV simulcast operation, basing equipment costs on a competitive market place; 2) Develop a family of market penetration projections in conjunction with SS/WP-3; and, 3) Investigate the implications of ATV policies for industrial development and international trade.

**E. Working Party 6: Subjective Assessment**

PS/WP-6's primary work assignment was to deliver still and dynamic video source material to ATTC in advance of the start of testing.<sup>2</sup> In support of this assignment, several tasks were identified:

1. Re-shoot, digitize and approve still test materials. Obtain rights to the test materials in writing.

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<sup>2</sup> The original work assignment specified delivery to ATTC on or before September 1, 1990. This date was postponed because of the later than expected delivery of the format converter.

2. Complete the camera tests for 1050/59.94/2:1, 787.5/59.95/1:1 and 525/59.94/1:1 formats.
3. Test the telecine to be used for transfer of 35mm, 24fps film.
4. Conduct the source material production methods demonstration. Priority is to demonstrate four identical serially shot sequences and sequences shot in 1125/60/2:1 converted to 1050/59.94/2:1 and 525/59.94/1:1.

As discussed below, PS/WP-6 addressed each of these matters successfully.

**F. Working Party 7: Audience Research**

Working Party 7 was asked to pursue funding for the audience research studies it had proposed and to monitor the activities of SS/WP-2 Task Force on Field Test procedures for possible equipment to be used for audience testing.

**IV. PROGRESS REPORT OF THE PLANNING SUBCOMMITTEE**

The Planning Subcommittee addressed all of the matters described above and essentially accomplished all of the objectives it established for itself. This section summarizes the specific progress made by the various working parties in the period January 1990 to January 1991.

**A. Progress Report of Working Party 1: Technology  
Attributes and Assessment and Working Party 2: ATV  
Testing and Evaluation Specifications**

The Working Parties agreed to address the following matters:

1. The need to supplement the testing of audio channels in the digital domain, and the objective testing of audio channels in the analog domain by subjective assessment;
2. Testing of image dynamic resolution;
3. Testing of compatible systems;
4. The use of "Showscan" 70mm film material;
5. Test method for ATV into IDTV receivers;
6. The use of pre-enhanced video material for testing;
7. Consider deleting the chroma resolution requirement in Section 6.2, and;
8. Source signal processing.

All of these matters were resolved through a series of joint meetings of the two Working Parties that were held on 29 May, 6 July, and 8 October, 1990. A summary of the findings on the above matters follows.

1. While objective testing of audio channels in both the digital and analog domain generally reveals the system's characteristics, such tests should be supplemented by subjective tests conducted by a panel of experts. The List of Attributes was amended. It was reaffirmed that the minimum audio service in an ATV system should be that required in current NTSC practice, i.e., one stereo audio pair,

and a SAP channel. Information on audio scrambling techniques was added to the List of Attributes.

2. Given that a dynamic zone plate test signal be used for testing dynamic resolution, it was determined that qualitative as well as quantitative assessments of the effect on the image be included.
3. For testing compatible systems, the FCC Regulations, Part 73 should be applied as appropriate.
4. To provide a signal source of the highest quality MTF, and having no lag, a special scanning technique applied to the Showscan system appears to be a suitable choice.
5. In testing any proponent system, sample IDTV receivers of the latest type should be used. The List of Attributes was amended to include "IDTV Receiver Compatibility."
6. Only un-enhanced and normalized video materials should be used for testing. In the case of camera generated images, "normalization" means that camera images be made to match electronically generated images as closely as possible. In addition, no images should be used for testing in which the noise component has been electronically reduced.
7. Recognizing the difficulty of obtaining MTF data without obtaining internal signals from proponent equipment, it was determined that indirect methods be used to quantify chroma response. The value to be measured is the smallest object that can be reproduced in color.
8. Two items were added to the List of Attributes:
  - 1.4.1 The performance of ATV systems which have been spatially or temporally prefiltered, including the use of motion detection.
  - 1.4.2 The performance of ATV systems in response to input signals having random noise, clock noise, etc., superimposed on them.



Beyond the original scope of work, field testing was considered, and it was determined that it was desirable to have more than one field test site. The List of Attributes was amended to include under Transmission Field Testing:

- 6.9.1        At least one location exhibiting an average amount of difficulty, and,
- 6.9.2        At least one location considered "difficult."

It was further noted that there are no plans to conduct field tests in the low-band VHF spectrum. Broadcasters in the Working Parties assert that transmission field tests should be conducted in both the VHF and the UHF bands.

In all, eight additions or amendments were made to the List of Attributes.

**B.    Progress Report of Working Party 3:    Spectrum Utilization and Alternatives**

As described below, PS/WP-3 has made several important contributions in the past twelve months. Among other things, the Working Party inaugurated a multi-faceted study of the extent of, and means for accommodating, ATV distribution and contribution capacity requirements. In addition, the Working Party further analyzed the relationships among various taboos and the degree to which these constraints might affect the number of existing broadcast stations accommodated under an ATV channel plan. Finally, the Working Party has also made

progress in developing ATV planning factors and, in response to an inquiry from the Systems Subcommittee, developed a qualitative list of spectrum-related characteristics that a preferred ATV transmission system would possess.

#### **1. Broadcast Auxiliary Capacity**

The Specialist Group dealing with broadcast support spectrum issues made progress in four areas:

First, critical issues were identified concerning the need for additional non-broadcast spectrum to support the deployment of a terrestrial ATV broadcast service. If, for example, the NTSC and ATV signals being simulcast are not identical or are distributed as separate NTSC and ATV formats, substantially more capacity could be required for contribution (e.g., ENG links) and distribution (e.g., STLs) circuits.

Second, proponents were solicited for their comments on the impact of their systems on the contribution and distribution systems used by broadcasters.

Third, a study was conducted of the impact of ATV broadcast support spectrum in North Carolina, representing the situation in the smaller markets. It was determined that, while each station could be provided with an additional STL channel to carry the ATV signal, higher performance antennas would be required.

Fourth, possible new spectrum was reviewed for ATV broadcast support services, and this study is fully reported in the attached PS/WP-3 report (Appendix C).

## **2. ATV Channel Availability**

Specialist Groups 6 and 7 have made further studies of the relationship between ATV channel availability and receiver taboos under various scenarios. Several preliminary findings have emerged from this ongoing work, as follows.

The maintenance of large adjacent channel separation distances, similar to that which exist today, would appear to produce the biggest single constraint on the availability of ATV channels. Consequently, fewer stations might receive an ATV channel if the new transmission system cannot co-exist adequately with adjacent channel NTSC stations.

On the other hand, other off-channel assignment restrictions, especially those related to intermodulation interference, are much smaller. Accordingly, the effect on the availability of ATV channels of maintaining some of these is relatively small. Moreover, except for the picture image taboo, the effect of increasing or decreasing the taboo separation distance has little or no impact on the accommodation statistics.

It was also discovered that the greatest number of existing stations could be assigned an ATV channel if ATV and

NTSC facilities were co-located. Furthermore, exact co-location would appear to offer the greatest benefit in this regard.

### **3. Planning Factors**

Specialist Group 10, concerned with the planning factors necessary to determine the basic service areas for ATV, continued its work. Starting with the existing NTSC Channel Allotment Plan, the Group has begun to identify and modify the factors, taking into account the new information on ATV channels and systems.

The Specialist Group also assisted SS/WP-4, by providing guidelines on how to judge the spectrum-related aspects of particular ATV systems. In addressing this issue, it was recognized that a computer program allowing the rapid preparation of graphical representations of interference-free service areas under a variety of geographic spacing and power/antenna height combinations would be valuable. The Zenith Corporation has developed a program for this purpose and offered its cooperation in refining the software for use by the Working Party.

**C. Progress Report of Working Party 4: Alternative Media Technology and Broadcast Interface**

Following the earlier work of PS/WP-4 in developing the concept of the "multiport" receiver, substantial progress has been made by the Electronic Industries Association ("EIA") and the Advanced Television Standards Committee ("ATSC") in addressing interoperability issues between the alternative media. These two groups have proposed three basic structures that will provide receiver manufacturers, television service providers, and consumers with standardized interfaces that can have various levels of performance and complexity.

In the course of this work, it has become apparent that ambiguous new terms have evolved in the ATV proceedings. Most importantly, the widely used term "ATV receiver" is now defined to consist of three components:

- A tuner/demodulator which yields non-carrier protocols
- An interface processor which will accept and process non-carrier signals from broadcast and alternative media, and
- A display device.

PS/WP-4 also has found that conditional access is a relevant attribute of an ATV transmission standard. Issues concerning this attribute requiring further study by appropriate organizations include: anti-taping mechanisms, consumer addressability, provision for "service on demand",

service tiers, universal access system, and, a "blackout" feature whereby real-time viewing can be disabled on a geographic region basis.

Much of the work of PS/WP-4 has been completed, and several organizations have initiated follow-up activities. It is believed that the interoperability concepts, test plans and definitions developed previously remain applicable in the digital domain.

**D. Progress Report of Working Party 5: Economic Factors and Market Penetration**

During the fourth period of work, PS/WP-5 concentrated on refining its receiver penetration estimates and appraising the cost to local broadcast stations of establishing a simulcast ATV service.

The new set of receiver market penetration scenarios was developed based on a set of modified assumptions, including an estimate of the price elasticity of ATV receivers, cost reductions driven by global economies of scale, and the assumption that Europe and Japan could introduce ATV service

before the U.S.<sup>3</sup> The new penetration scenario posited that the ATV receiver penetration will be five percent five years after the introductory one percent point has been achieved, and 30 percent after ten years.<sup>4</sup>

In the latter part of the work period, important new considerations have led to a further revision in the

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<sup>3</sup> In addition, a more detailed review of the validity of the historical models which had been used as a guide to market penetration was conducted. It was found that the models of color TV and the VCR were flawed in that they did not adequately represent the market environment in which ATV service would most likely be introduced in the U.S. Thus, the penetration of color TV in the introductory period was significantly constrained by the lack of color programming, and the VCR at its introduction was used mainly for time-shifted viewing of broadcast TV programs, there being a general lack of different programs available on cassette.

<sup>4</sup> Firstly, feature films produced on 35mm Film, are in fact high definition, and they can be readily transferred to the HD format for broadcast. Equally, virtually all television drama and movies-of-the-week, constituting 70 percent of prime time programming, are also shot on 35mm film, and these too can be transferred to the HD broadcast format.

For the remaining programs that have been produced electronically in the current 525-line NTSC format, the NTSC signal may be "up-converted" to the HD format, and broadcast on the simulcast channel, much as synthesized stereo audio has been used in the introduction of full stereo audio television service. This option however, results in a black curtain at each side of the 4:3 aspect ratio picture.

A second option, which is appropriate when local origination is required, is to shoot studio productions with a 525-line camera adapted for a 16:9 aspect ratio lens and recorded on a 16:9 aspect ratio VTR. This signal would then be broadcast on the simulcast channel, while a narrow screen down-conversion would be broadcast on the NTSC channel.

While neither of these options provides true High Definition, subjectively they will be superior to NTSC, and will serve as an interim measure during the introductory period of HD penetration.

penetration estimates. The most important technical development is the broad emergence of all-digital transmission systems. One important consequence of these systems, uncovered in independent studies submitted to PS/WP-5 by CBS and PBS, is that the anticipated cost of transition to ATV simulcast service will be much lower than previously projected. This fact should encourage stations to convert more rapidly.

Based on certain assumptions,<sup>5</sup> the CBS study projected that the first 30 stations to convert to ATV would incur capital and labor costs of approximately \$12 million over a five-year transition period. It is further projected that subsequent groups of stations, each twice as large as the previous group, would start the transition process in succeeding years, and would extend the period of conversion over longer periods. Thus, for stations in smaller markets, the annual capital investment would be reduced (less than \$8 million), and the actual cost of each phase of the conversion would be reduced through the economies of scale developed. The full studies of the transition scenarios developed by

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<sup>5</sup> The CBS analysis is founded on four general assumptions: 1) Stations in the largest markets will convert to ATV first; 2) The transition will take place in phases, and will extend over several years; 2) The ATV transmission system will require lower power than current NTSC transmission systems, and will use a smaller antenna; and, 4) Each doubling of HD equipment manufactured will lead to a 10 percent reduction in the prior cost.



both PBS and CBS are appended to the PS/WP-5 report (Appendix E).

Based upon the economic impact of new digital transmission technology, and upon the feasibility of providing a reasonably complete broadcast schedule on the ATV simulcast channel at the outset,<sup>6</sup> the Chairman of PS/WP-5 concluded that the second penetration scenario's upper and more optimistic bound now has greater validity. This upper bound projects a 10 percent penetration in five years, and a 40 percent penetration in 10 years, both terms being subsequent to the achievement of the introductory one percent penetration.<sup>7</sup>

#### **E. Working Party 6: Subjective Assessment**

During this period, the efforts of the Working Party were centered on one primary task -- that of producing the

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<sup>6</sup> Obviously, at the outset, much of the programming on the simulcast channels will not be electronically produced ATV material. Instead, as is the case today, the bulk of the primetime programming is expected to be 35mm film (inherently high definition), converted to the ATV transmission format.

<sup>7</sup> This initial penetration point could well be reached much earlier than was the case with color TV because improved quality programming can be made available at the introduction of ATV service. Moreover, it remains likely that ATV home video players and ATV cable service will in fact precede the introduction of ATV terrestrial broadcasting, and even seed the market to the one percent penetration point before the ATV terrestrial service is inaugurated.